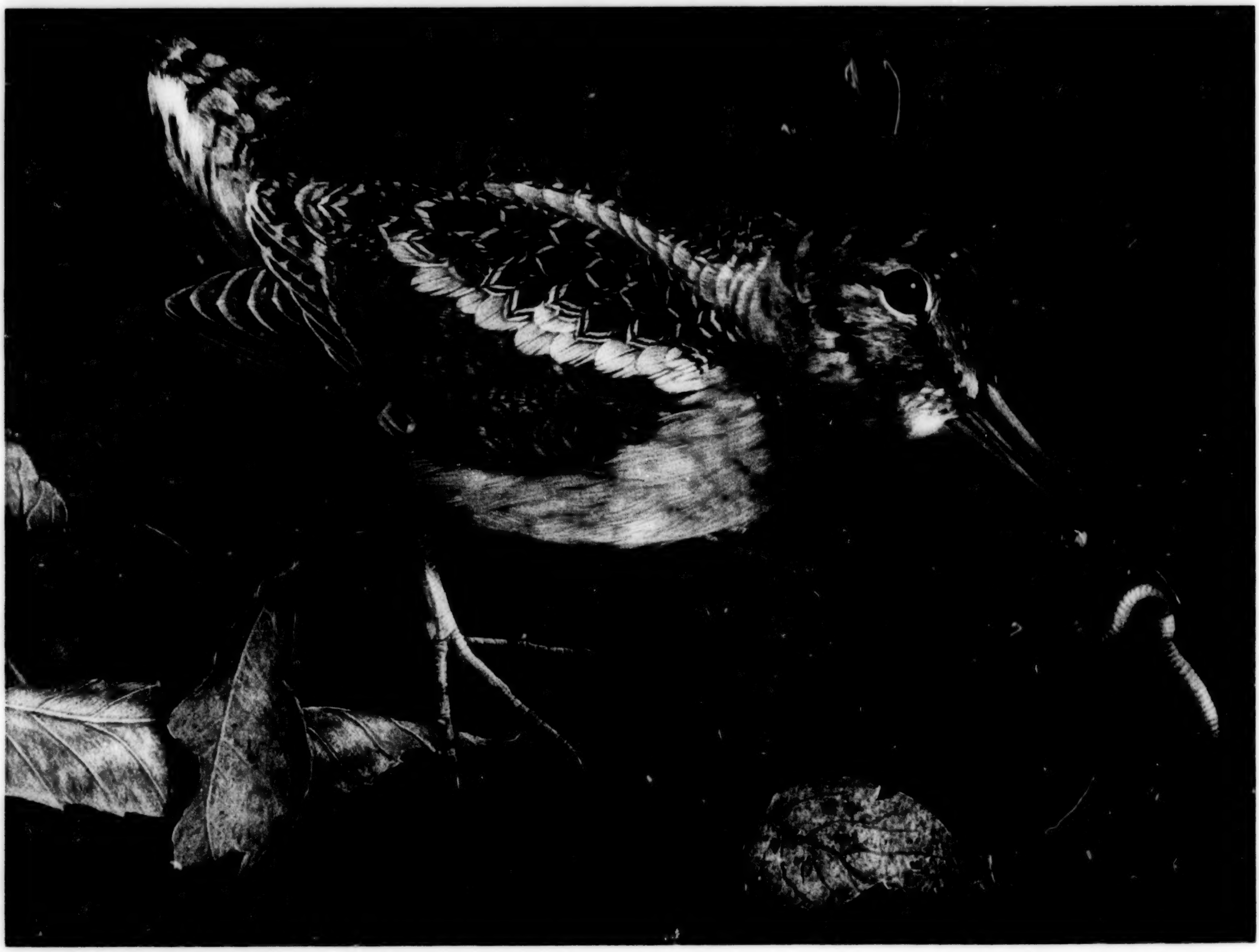
I 49. 106/6:993

JUN 16 1993

American Woodcock

Harvest and Breeding Population Status, 1993



Department of the Interior

U.S. Fish & Wildlife Service

AMERICAN WOODCOCK HARVEST AND BREEDING POPULATION STATUS, 1993

J. Ashley Straw, Jr., U. S. Fish and Wildlife Service, Office of Migratory Bird Management, Laurel, MD 20708-4016

Abstract: Wing-collection and Singing-ground Surveys were conducted to determine the population status of American Woodcock. Age-ratio information from harvested woodcock indicated that the 1992 recruitment index (ratio of immatures to adult females) was well below the long-term average for the Eastern Region (-17.6%) and somewhat lower than the long-term average for the Central Region (-11.1%). The 1992 recruitment indices were 1.4 immatures per adult female in the Eastern Region and 1.6 in the Central Region. Daily hunting success in the Eastern Region increased from 1.8 in 1991 to 2.0 woodcock bagged per day in 1992 (+11.1%), while the seasonal success index increased from 7.5 to 8.8 woodcock bagged per season (+17.3%). In the Central Region, the daily success index remained at 2.4 birds per day in 1991 and 1992, while the seasonal success index decreased from 12.9 to 11.7 woodcock bagged per season (-9.3%). Analysis of Singing-ground Survey data using route regression methodologies indicated no regional changes in the number of singing males between 1992 and 1993 ($P > 0.10$). However, there were significant ($P < 0.01$) long-term (1968-93) declines of 1.8% per year in the Eastern Region and 0.9% per year in the Central Region. Recent (1985-93) trends in the Singing-ground Survey were also negative (-1.5% and -1.7% for the Eastern and Central Regions respectively) ($P < 0.05$). During the past 9 years, breeding population indices of woodcock declined significantly ($P < 0.10$) in Connecticut, Maine, New Jersey, West Virginia, Ontario and Wisconsin. Conversely, the index for Indiana increased significantly over this time period .

The American woodcock (*Scolopax minor*) is a popular game bird throughout eastern North America, providing an estimated 3.4 million days of recreational hunting annually (U.S.D.I. 1988). As stated in the recently released *American Woodcock Management Plan*, the management objective of the U.S. Fish and Wildlife Service (FWS) is to increase population levels of woodcock to levels consistent with the demands of consumptive and non-consumptive users.

Reliable annual estimates of population size, productivity, harvest size and distribution are fundamental to comprehensive woodcock management. Unfortunately, this information is difficult and often impractical to obtain. Woodcock are difficult to find and count because of their cryptic coloration, small size, and preference for dense vegetation. Also, no comprehensive sampling frame for woodcock hunters exists. Because of these difficulties, the *Wing-collection Survey*, and the *Singing-ground Survey* were developed to provide indices of populations, productivity and harvest levels. These surveys allow biologists to monitor the status of woodcock populations and aid wildlife administrators in setting harvest regulations. This report summarizes the results of the 1992 Wing-collection Survey and the 1993 Singing-ground Survey, and presents an assessment of the population status of woodcock as of June 1993.

The primary purpose of this report is to facilitate the prompt distribution of timely information. Results are preliminary and may change with the inclusion of additional data.

Cover art used with permission of Nancy Howe, Nancy Howe Studio, East Dorset, Vermont.

METHODS

Woodcock Management Units

Woodcock are managed on the basis of two regions or populations, Eastern and Central, as recommended by Owen et al. 1977 (Fig. 1). Coon et al. (1977) reviewed the development of the concept of management units for woodcock and recommended the current configuration above several alternatives. This configuration was biologically justified because analysis of band recovery data indicated that there is little crossover between the regions (Krohn et al. 1974, Martin et al. 1969). Furthermore, the regional boundaries conform with the boundary between the Atlantic and Mississippi waterfowl flyways. The results of the Wing-collection Survey and Singing-ground Survey are reported by region and state or province.

Wing-collection Survey

The Wing-collection Survey was developed in the early 1960's to monitor the productivity of woodcock. It is administered as a cooperative effort between woodcock hunters, FWS, and state wildlife agencies. Survey participants in the 1992 survey included hunters who: (1) participated in the previous year's survey; (2) requested that they be included in the survey; or (3) indicated on the 1991-92 Annual Questionnaire Survey of U. S. Waterfowl Hunters that they hunted woodcock. Wing-collection Survey participants were provided with prepaid mailing envelopes and asked to submit one wing from each woodcock they bagged. In addition, the hunters were asked to record the effort and success of their hunts. Age and sex ratios in the harvest were determined by examining plumage characteristics (Martin 1964) during the annual FWS "wingbee" (a cooperative work session).

The ratio of immature birds per adult female provided an index to production during the 1992 breeding season. Annual indices were compared to the long-term (1963-91) ratio of immatures per adult female. Annual indices were calculated as the average number of immatures per adult female in each state, weighted by the relative contribution of each state to the total number of wings received in 1963-91 (to maintain comparability between years).

The daily and seasonal bags of hunters who participated in the Wing-Collection Survey in both 1991 and 1992 were used as indices of hunter success. These indices were weighted to compensate for changes in the proportion of the estimated woodcock harvest attributable to each state and adjusted to a base-year value (1969) for comparison with previous years (Clark 1970, 1972, 1973).

Singing-ground Survey

The Singing-ground Survey was developed to exploit the conspicuous courtship display of the male woodcock. Early studies demonstrated that counts of singing males provided indices to woodcock populations and could be used to monitor annual changes (Mendall and Aldous 1943, Goudy 1960, Duke 1966, and Whitcomb 1974). Before 1968, counts were conducted on non-randomly located routes. Beginning in 1968, routes were relocated along lightly traveled secondary roads in the center of randomly chosen 10-minute blocks within each state and province in the central and northern portions of the woodcock's breeding range (Fig. 1). Data collected prior to 1968 are not included in this report.

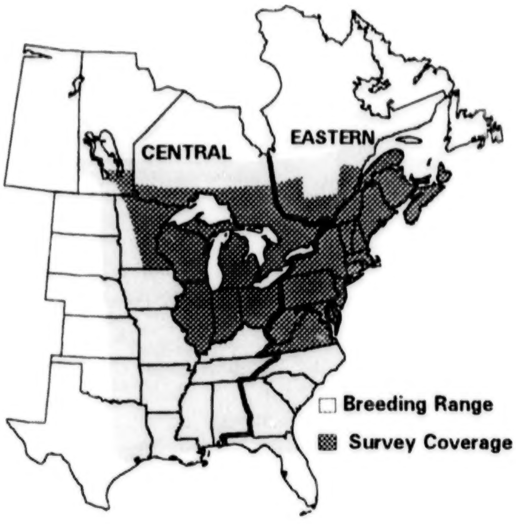


Fig. 1. Woodcock management regions, breeding range, and Singing-ground Survey coverage.

The survey consists of approximately 1,500 routes, each route being 3.6 miles long and consisting of 10 listening points. The routes are surveyed shortly after sunset by an observer who drives to each of the 10 stops and records the number of woodcock heard "peenting". Acceptable dates for conducting the survey were assigned by latitude to coincide with peaks in courtship behavior of local woodcock. In most states, the peak of singing activity (including migrant and local woodcock) occurs earlier in the spring and local reproduction may already be underway when the survey is conducted. However, it is necessary to conduct the survey during the designated survey dates in order to avoid counting migrating woodcock. Because adverse weather conditions may affect singing behavior or listening conditions, surveys are only conducted when wind, rain, and temperature conditions are acceptable.

In order to avoid expending unnecessary manpower and funds, approximately one half of the 1,500 Singing-ground Survey routes are run each year. The balance of these routes are carried as "constant zeros." Routes for which no woodcock are heard for at least two consecutive years enter this constant zero status and are run once every 5 years until woodcock were heard. Once woodcock are heard, the route enters a normal status and is again run each year. Data from constant zero routes are included in the analysis only for the years they were actually surveyed. Sauer and Bortner (1991) reviewed the implementation and analysis of the Woodcock Singing-ground Survey in more detail.

Route Regression Methodology. -- Trends were estimated for each route by fitting a line using linear regression of the natural logarithm of the original counts +0.5, versus year (Geissler 1984, Geissler and Sauer 1990). Observer data were used as covariables in the regression to adjust for differences in observers' ability to hear woodcock. To estimate state and regional trends, the slope estimates of the individual routes were back-transformed and weighted average slopes were calculated for the areas of interest as described by Geissler (1984). Regional estimates were weighted by state and provincial land areas. Variances associated with the state, provincial, and regional slope estimates were estimated using a bootstrap procedure (Efron 1982). The slope estimates were expressed as percent change per year. See Sauer and Bortner (1991) for a detailed description of this method as applied to the woodcock Singing-ground Survey. Trend significance was assessed using percentile-based confidence intervals (Efron 1982) where $P<0.10$ was considered significant.

The reported sample sizes are the number of routes on which a given trend estimate is based. This number may be less than the actual number of routes run for several reasons. Route regression analyses cannot use routes on which no birds were heard during the interval of interest, hence these routes were not included in the sample size. Each route should be surveyed during the peak time of woodcock singing activity. For editing purposes, "acceptable" times were between 22 and 58 minutes after sunset. (Or, between 15 and 51 minutes after sunset on overcast evenings.) Due to observer error, some stops on some routes were surveyed before or after the peak times of woodcock singing activity. Earlier analysis showed that routes with 8 or less "acceptable" stops tend to be biased low. Therefore, only route observations with 10 stops, of which at least 9 were acceptable, were included in the analysis. Routes for which data were received after June 1, 1993 were not included in this analysis but will be included in future long-term trend estimates.

Annual Indices Estimation. -- Annual indices were calculated for the two regions and each state or province by finding the deviation between the observed count on each route and that predicted by the regional or state/provincial trend estimate. These residuals were averaged by year and added to the fitted trend to produce annual indices of abundance for each region, state, or province. (Yearly variation in woodcock abundance was superimposed on the long-term fitted trends. See Sauer and Geissler 1990.) The advantage of this method is that the indices calculated provide a realistic representation of annual variation about a fitted trend. In order to estimate the percent change from 1992 to 1993, a short-term trend (2 years) was calculated. The percent change estimated from this short-term trend analysis is the best estimator of annual change. Attempts to estimate short-term trends from the ratio of annual population indices (which were derived from residuals of the long-term trends) will yield less precise results.

Recent Trends. -- Recent trends in the Singing-ground Survey (1985-93) were also evaluated. The choice of a beginning point for this analysis was somewhat arbitrary, but 1985 was chosen because significant regulatory changes were enacted in the Eastern Region in that year due to the poor population status of woodcock in that region. This evaluation is not intended to imply that a relationship exists between woodcock population trends and harvest regulations; however, it is appropriate to evaluate the trend of woodcock populations from a time when they were considered to be low.

RESULTS

Wing-collection Survey

A total of 7,490 potential woodcock hunters were contacted and asked to participate in the 1992 Wing-collection Survey. Twenty-eight percent (Table 1) cooperated by submitting 13,510 wings (Table 2) and supplemental information on 4,033 hunts (Table 3). Northern hunters submitted more wings than southern hunters, leading to an unbalanced geographic distribution in the wing sample.

Recruitment. -- The ratio of immature woodcock to adult females in the harvest provides an index of recruitment to the population during the previous breeding season. In that portion of the Eastern Region in the United States, the recruitment index of 1.4 immatures per adult female was lower than the long-term average (-17.6%, Table 2, Fig. 2). Meanwhile, the recruitment index in that portion of the Central Region in the United States was 1.6 (11.1% below the long-term average).

Hunting Success. -- Daily hunting success in the Eastern Region increased from 1.8 in 1991 to 2.0 woodcock bagged per day in 1992 (+11.1%, Table 3), while the seasonal success index increased from 7.5 to 8.8 woodcock bagged per season (+17.3%). Despite these increases, the base-year adjusted indices of daily and seasonal hunting success remain below the long-term average in the Eastern Region (Figs. 3 and 4). In the Central Region, the daily success index remained at 2.4 birds per day in 1991 and 1992, while the seasonal success index decreased from 12.9 to 11.7 woodcock bagged per season (-9.3%, Table 3). The base-year adjusted index of daily hunting success in the Central Region remains near the long-term average while the index of seasonal hunting success continues to decline (Figs. 3 and 4).

Singing-ground Survey

Route Regression. -- Short-term (1992-93) trend analysis showed significant ($P<0.10$) decreases in the number of woodcock heard in New Jersey, Virginia and Indiana. There was a significant increase in the number of woodcock heard in Illinois (Table 4). However, these trend estimates and significance tests are imprecise when few routes were run. Several states/provinces had less than 10 comparable routes (Fig. 5).

Long-term (1968-93) trends were computed from 688 routes in the Eastern Region and 661 routes in the Central Region. Delaware, Rhode Island, and Manitoba had less than 10 useable routes during the 26-year period (Fig. 6). In the Eastern Region, significant ($P<0.10$) long-term declining trends were noted for Connecticut, Maine, Maryland, Massachusetts, New Brunswick, New Jersey, Nova Scotia, Pennsylvania, Rhode Island, Vermont, Virginia and the entire region (Table 4). A significant long-term increase was noted for Quebec ($P<0.05$). The long-term trend estimate for the Eastern Region was -1.8% per year ($P<0.01$).

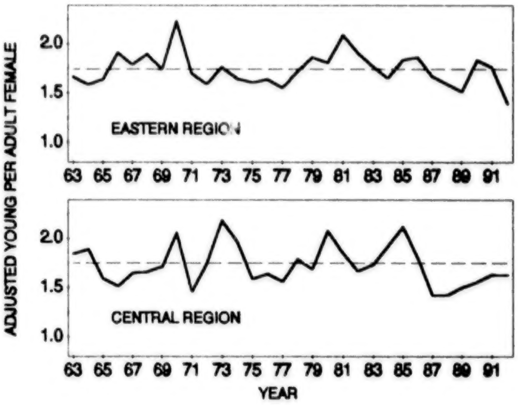


Fig. 2. Adjusted annual indices of recruitment, 1963-1992. Dashed line is the index based on years, 1963-91 combined.

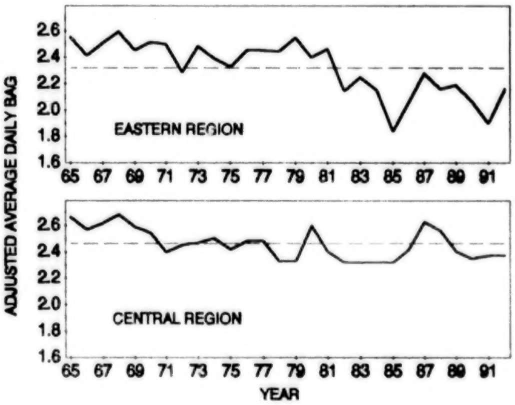


Fig. 3. Base-year adjusted indices of daily hunting success, 1965-92. Base-year is 1969. **Dashed line is the** 1965-92 average.

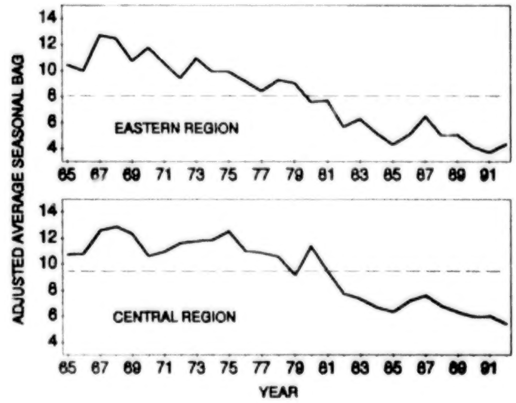


Fig. 4. Base-year adjusted indices of **seasonal hunting** success, 1965-92. Base-year is 1969. **Dashed line is the** 1965-92 average.

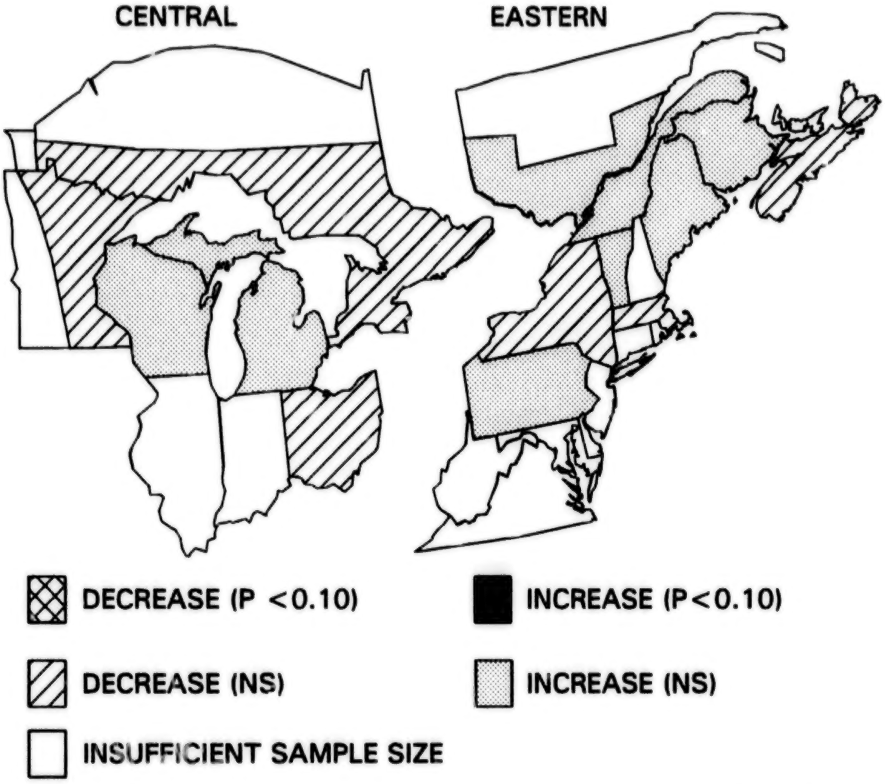


Fig. 5. Short-term trends in number of American woodcock heard on the Singing-ground Survey; 1992-93.

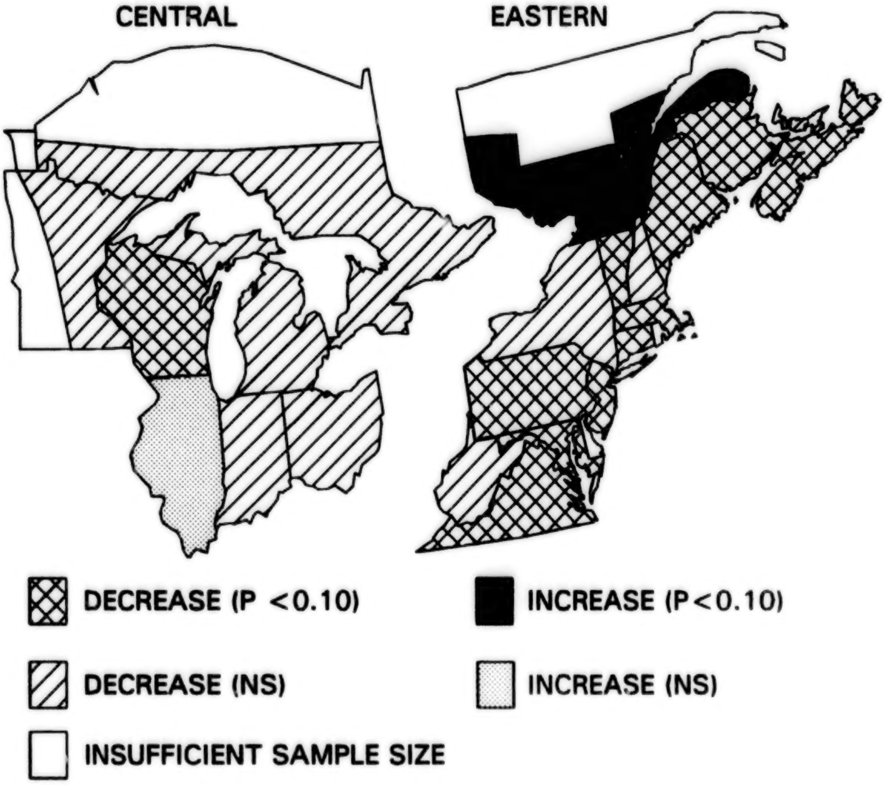


Fig. 6. Long-term trends in number of American woodcock heard on the Singing-ground Survey; 1968-93.

In the Central Region, significant ($P<0.10$) long-term declining trends were noted for Wisconsin and the Central Region. The long-term trend for the Central Region was -0.9% per year ($P<0.01$).

Annual Breeding Population Indices. -- Last year's breeding population index for the Eastern Region was below the predicted index and was the lowest on record (Straw 1992). The 1993 breeding population index is virtually unchanged from 1992 (1.86 versus 1.87, Table 5, Fig. 7). The predicted value, based on a constant rate of decline, is 1.92 singing males per route. The Central Region population index of 2.09 singing males per route is identical to the 1992 value and less than the predicted index of 2.22 males per route.

Recent Trends. -- Recent (1985-93) trends were computed for 449 routes in the Eastern Region and 498 routes in the Central Region. Connecticut, Delaware, Rhode Island and Manitoba had less than 10 useable routes during the 9 year period. The Eastern and Central Region breeding population trends were -1.5 ($P<0.05$) and -1.7 ($P<0.01$), respectively (Table 4). In addition, Connecticut, Maine, New Jersey, West Virginia, Ontario and Wisconsin had significantly decreasing trends. The breeding population index for Indiana increased during this time period ($P<0.10$).

DISCUSSION

Wing-collection Survey

The ratio of immatures per adult female observed in the Eastern Region was the lowest on record, reflecting the effects of unfavorable nesting and brood-rearing weather in 1992. Nesting and brood-rearing conditions in the Central Region were also less than optimal, but the impact on productivity was not as pronounced as in the Eastern Region.

Between 1991 and 1992, there were no changes in Federal frameworks for woodcock hunting. Letters received from hunters indicated that hunting conditions in the northeast were considerably improved over 1991 and this was reflected in the increased indices of hunter success relative to last year. However, the long-term decline in daily hunting success of cooperators in the Eastern Region probably reflects decreased numbers of woodcock. The long-term decline in seasonal hunting success is probably the result of lower daily hunting success and perhaps a reduction in the number of days afield. The winter of 1992 was unseasonably warm, and field reports indicated that fewer woodcock were found in Louisiana than in most years. Those birds which did winter in Louisiana were heavier than normal, indicating good nutritional status (M. Olinde, La. Dept. of Wild. and Fish., unpublished data). In the Central Region, seasonal success has remained below the long-term average since 1982 while daily hunting success has not changed dramatically. This suggests that the number of days cooperators spend hunting woodcock in the Central Region may have declined over the long term.

Indices based on the Wing-collection Survey should be interpreted cautiously in light of the potential biases associated with the non-random sampling procedure by which survey participants were selected. Although not quantified, these biases may have affected the results of the survey. A comprehensive critique of these problems is beyond the scope of this report, so readers are directed to Owen et al. (1977).

Singing-ground Survey

The results of the Singing-ground Survey showed no improvement over last year's low count. The low number of woodcock heard in 1992 and 1993 may have been caused by a

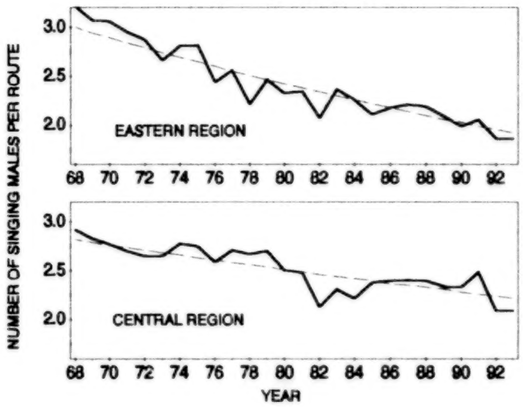


Fig. 7. Long-term trends and annual indices of number of woodcock heard on woodcock Singing-ground Survey, 1968-93.

decline in the number of male woodcock displaying on the singing grounds or to weather related effects on woodcock behavior. A major spring blizzard deposited 12-36+ inches of snow and ice in the Appalachian Mountains and throughout the mid-Atlantic and northeastern states during 12-14 March, 1993. This storm coincided with the spring migration of woodcock, occurring at a time when many woodcock were as far north as Pennsylvania. Snow-cover persisted for approximately one week in most areas. Due to the timing and severity of this storm, woodcock survival may have been impacted. Alternatively, cool spring weather may have suppressed woodcock courtship behavior. Many observers reported that the spring of 1993 was characterized by cooler than normal temperatures in the northern portions of the woodcock breeding range (as was the spring of 1992.) However, because the quantitative effect of atypical spring weather on woodcock "peenting" behavior is not known, it is difficult to attribute the observed decline to a specific cause.

It had appeared that woodcock populations may have stabilized in both regions during 1985-91 (Straw 1991, 1992). However, due primarily to the low counts of 1992-93, the regional trends from 1985-93 were negative in this analysis. Meanwhile, most states/provinces show long-term declines and several show declines over 1985-93. These negative population trends are likely to continue unless current trends in habitat loss are reversed.

Due to the ephemeral nature of woodcock habitat, continual maintenance and creation of habitat is critical if woodcock populations are to be maintained at their current level. Continued population declines are likely unless the loss of early-successional forest habitat is halted. Implementation of sustained-yield forest management on public and private lands is one key to maintaining woodcock populations and biological diversity within the woodcock breeding range.

WORKSHOP ANNOUNCEMENT

Interested biologists and foresters are invited to attend the workshop "Enhancing Biological Diversity in the Northeast Through Management of Early Successional Forests" to be held July 14-16, 1993 in Ithaca, New York. This workshop focuses on the integration of timber production, wildlife habitat management and landscape ecology into land management practice. Special emphasis will be placed on the importance of early-successional forests to regional diversity. Interested persons should call Cornell Cooperative Extension (607) 255-2127 for registration information.

ACKNOWLEDGEMENTS

Personnel from the U.S. Fish and Wildlife Service, Canadian Wildlife Service, and the many state and provincial agencies as well as other individuals assisted in collecting the Singing-ground Survey data and processing wings at the Wing-collection "wingbee." The 1993 "wingbee" was hosted by the Louisiana Department of Wildlife and Fisheries. Special appreciation is extended to Mike Olinde who coordinated this work session. Individuals who helped with the wingbee were: M. Olinde, F.

Kimmel (Louisiana Dept. of Wildl. and Fish.); D. Dessecker (The Ruffed Grouse Society); J. Arnold, B. Gentry, D. Krementz, G. Sepik, and P. Yakupzack (USFWS); T. Carlson, and B. Odom (Michigan DNR). Many woodcock hunters cooperated by sending in wings and supplemental hunting information. J. R. Sauer developed the method for calculating annual indices and refined the route regression programs for analysis of the Singing-ground Survey data. W. L. Kendall conducted the analysis, provided statistical support and reviewed earlier drafts of this report. F. Hicks and L. Whitman provided computer programming and computer processing support. Data entry was conducted by S. P. Windham and the Electronic Data Processing Section of the Office of Migratory Bird Management. P. Keywood prepared the figures. G. Smith reviewed the manuscript and provided helpful comments. Special thanks are due the regional, state, and provincial Singing-ground Survey coordinators. I am especially grateful to M. A. McKeogh, who provided valuable assistance in conducting both surveys, processed data forms, and provided secretarial support. Portions of this report were copied in whole or in part from previous status reports.

LITERATURE CITED

Clark, E. R. 1970. Woodcock status report, 1969. U.S. Fish Wildl. Serv., Spec. Sci. Rep.-- Wildl. 133. 35 pp.

____. 1972. Woodcock status report, 1971. U.S. Fish Wildl. Serv., Spec. Sci. Rep.-- Wildl. 153. 47 pp.

_____. 1973. Woodcock status report, 1972. U.S. Fish Wildl. Serv., Spec. Sci. Rep.--Wildl. 169. 50 pp.

Coon, R. A., T. J. Dwyer and J.W. Artmann. 1977. Identification of harvest units for the American woodcock. Proc. American Woodcock Sym. 6:147-153.

Duke, G. E. 1966. Reliability of censuses of singing male woodcock. J. Wildl. Manage. 30(4):697-707.

Efron, B. 1982. The jackknife, the bootstrap and other resampling plans. Society for Industrial Applied Mathematics, Philadelphia, PA. 92 pp.

Geissler, P. H. 1984. Estimation of animal population trends and annual indices from a survey of call-counts or other indicators. Proceedings American Statistical Association, Section on Survey Research Methods, 472-477.

Geissler, P. H., and J. R. Sauer. 1990. Topics in route-regression analysis. Pages 54-57 in J. R. Sauer and S. Droege, eds. Survey designs and statistical methods for the estimation of avian population trends. U.S. Fish and Wildl. Serv., Biol Rep. 90(1). 166 pp.

Goudy, W. H. 1960. Factors affecting woodcock spring population indexes in southern Michigan. M.S. Thesis. Michigan State Univ., E. Lansing. 44 pp. (Also published in: Mich. Dep. Conserv., Game Div. Rep. 2281. 44 pp).

Krohn, W. B., F. W. Martin, and K. P. Burnham. 1974. Band recovery distribution and survival estimates of Maine woodcock. 8 pp. In Proc. Fifth American Woodcock Workshop, Athens, Ga., December 3-5, 1974.

Martin, F. W. 1964. Woodcock age and sex determination from wings. J. Wildl. Manage. 28(2):287-293.

Martin, F. W., S. O. Williams III, J.D. Newsom, and L. L. Glasgow. 1969. Analysis of records of Louisiana-banded woodcock. Proc. 3rd Annu. Conf. Southeastern Assoc. Game and Fish Comm. 23:85-96.

Mendall, H. L., and C. M. Aldous. 1943. The ecology and management of the American woodcock. Maine Cooperative Wildlife Research Unit, Univ. Maine, Orono. 201 pp.

Owen, R. B., Jr., J. M. Anderson, J. W. Artmann, E. R. Clark, T. G. Dilworth, L. E. Gregg, F. W. Martin, J. D. Newsom, and S. R. Pursglove, Jr. 1977. American woodcock (*Philohela minor* = *Scolopax minor* of Edwards 1974). Pages 149-186 in G.C. Sanderson ed. Management of migratory shore and upland game birds in North America. Int. Assoc. Fish and Wildl. Agencies, Washington, D.C.

Sauer, J. R., and J. B. Bortner. 1991. Population trends from the American woodcock singing-ground survey, 1970-88. J. Wildl. Manage. 55(2):300-312.

Sauer, J. R., and P. H. Geissler. 1990. Estimation of annual indices from roadside surveys. Pages 58-62 in J. R. Sauer and S. Droege, eds. Survey designs and statistical methods for the estimation of avian population trends. U.S. Fish and Wildl. Serv., Biol Rep. 90(1). 166 pp.

Straw, J. A. 1991. Woodcock status report, 1991. U.S. Fish Wildl. Serv. Admin. Rep. 14 pp.

Straw, J. A. 1992. Woodcock status report, 1992. U.S. Fish Wildl. Serv. Admin. Rep. 15 pp.

USDI. 1988. 1985 National Survey of Fishing, Hunting and Wildlife-Associated Recreation. U.S. Govt. Printing Office, Wash. D.C.

Whitcomb, D. A. 1974. Characteristics of an insular woodcock population. Mich. Dept. Nat. Resour., Wild. Div. Rep. 2720. 78 pp.

Table 1. Distribution of hunters contacted and response rates in 1992-93 woodcock wing collection survey.

State of residence	Number of contacts by code[a]					Total contacts	No. of cooperators	Percent cooperating
	1	2	4	6	9			
AL	2	32		1		35	1	3
AK	1	1				2		
AZ		11				11		
AR	4	37		4		45	3	7
CA		76				76		
CO		58				58	1	2
CT	74	60	3	28		165	54	33
DE	7	22		1		30	6	20
DC		1				1		
FL	7	36	1			44		
GA	9	58		5		72	8	11
ID		23				23		
IL	35	141	1	8		185	21	11
IN	38	63	8	15		124	36	29
IA	25	65		9		99	14	14
KS	5	46		4		55	3	5
KY	17	50		5		72	13	18
LA	123	123	2	26		274	74	27
ME	94	127	4	26		251	109	43
MD	12	54		6		72	7	10
MA	127	134		39		300	86	29
MI	493	535	13	102		1143	470	41
MN	199	347	4	59		609	163	27
MS	2	37		2		41	1	2
MO	33	92	1	10		136	33	24
MT		13		2		15		
NE	5	37		1		43		
NH	68	57	5	14		144	67	47
NJ	43	68		14		125	38	30
NM		15				15		
NY	205	286	3	41		535	192	36
NC	26	82		7		115	11	10
ND	1	18		1		20		
OH	73	140	1	37		251	70	28
OK	3	30		3		36	2	6
PA	161	421	2	51		635	178	28
RI	16	16		4		36	9	25
SC	9	54		9		72	11	15
SD		20				20		
TN	15	61		2		78		
TX	8	124		1		133	4	3
UT		21		1		22		
VT	57	33	2	8		100	53	53
VA	33	53		11		97	22	23
WA		3				3		
WV	13	9	1	3		26	8	31
WI	331	604	1	92		1028	307	30
WY		18				18		
Total	2374	4412	52	652	0	7490	2075	28

[a] Code 1 - Previous year's Code 1,2,4, and 9 hunters who submitted wings.
Code 2 - Waterfowl harvest survey hunters who reported hunting woodcock.
Code 4 - Requested participation or proposed by fellow hunter.
Code 6 - Previous year's Code 1 who did not submit wings.

Table 2. Comparison of woodcock recruitment indices for 1992 against the 1963-91 averages by state and region. Woodcock recruitment indices for individual states were calculated as the ratio of immatures per adult female. The regional indices for 1992 are calculated as the average of the state values, adjusted for comparability with the 1963-1991 average.

State of harvest	Number of wings received		Adult females		Immatures		Immatures per adult female	
	1963-91	1992	1963-91	1992	1963-91	1992	1963-91	1992
Eastern Region								
CT	12048	161	2620	47	7432	82	2.8	1.7
DE	376	14	52	1	259	11	5.0	a
FL	657	0	148	0	410	0	2.8	a
GA	2554	16	785	3	1100	9	1.4	a
ME	65084	1139	18984	366	32628	588	1.7	1.6
MD	3376	21	822	5	1915	11	2.3	a
MA	16691	295	4956	98	8447	122	1.7	1.2
NH	22283	674	7089	243	10476	279	1.5	1.1
NJ	23178	151	5344	20	13683	104	2.6	5.2
NY	43612	1067	14117	406	20720	430	1.5	1.1
NC	2471	21	716	9	1239	8	1.7	a
PA	23957	510	7382	208	11346	174	1.5	0.8
RI	2021	31	376	8	1373	20	3.7	a
SC	1787	28	523	15	920	11	1.8	a
VT	16504	545	5190	211	7858	209	1.5	1.0
VA	2789	84	596	30	1750	34	2.9	a
WV	4650	84	1394	34	2383	29	1.7	a
Region	244038	4841	71094	1704	123939	2121	1.7	1.4
Percent change								-17.6%
Central Region								
AL	907	2	241	2	425	0	1.8	a
AR	454	5	152	3	185	0	1.2	a
IL	1064	27	227	14	616	9	2.7	a
IN	5726	170	1403	41	3258	100	2.3	2.4
IA	522	50	182	22	240	9	1.3	a
KS	37	0	9	0	20	0	a	a
KY	811	37	188	12	425	19	2.3	a
LA	24076	895	5312	156	15857	616	3.0	3.9
MI	70724	3631	22544	1117	36402	1811	1.6	1.6
MN	18633	1377	6072	492	9033	527	1.5	1.1
MS	1645	1	467	0	838	0	1.8	a
MO	1930	73	466	28	982	28	2.1	a
NE	10	0	4	0	5	0	a	a
OH	11053	500	3368	143	5353	230	1.6	1.6
OK	149	2	33	2	80	0	2.4	a
TN	774	2	184	1	399	0	2.2	a
TX	939	4	237	2	484	2	2.0	a
WI	47024	1893	14959	621	23486	928	1.6	1.5
Region	186478	8669	56048	2656	98088	4279	1.8	1.6
Percent change								-11.1%

a Number of wings received was less than 125.

Table 3. Comparison of state and regional indices to daily and seasonal woodcock hunting success. State and regional indices are calculated for states represented by at least 10 hunters who participated in both years. Regional indices were weighted by the estimated woodcock harvest in those states.

State of residence	Number of hunters	Number of hunts		Woodcock bagged		Average bag per hunt		Average bag per season	
		1991	1992	1991	1992	1991	1992	1991	1992
Eastern Region									
CT	22	61	65	89	105	1.5	1.6	4.0	4.8
DE	2	3	4	8	10	a	a	a	a
FL	0					a	a	a	a
GA	2	2	4	2	5	a	a	a	a
ME	52	305	308	634	611	2.1	2.0	12.2	11.8
MD	1	1	1	1	1	a	a	a	a
MA	35	134	109	206	174	1.5	1.6	5.9	5.0
NH	35	184	192	315	367	1.7	1.9	9.0	10.5
NJ	17	59	64	110	120	1.9	1.9	6.5	7.1
NY	78	353	383	614	788	1.7	2.1	7.9	10.1
NC	7	31	12	56	16	a	a	a	a
PA	48	109	144	167	312	1.5	2.2	3.5	6.5
RI	3	18	17	34	24	a	a	a	a
SC	2	4	7	7	9	a	a	a	a
VT	28	118	135	222	256	1.9	1.9	7.9	9.1
VA	8	26	32	36	48	a	a	a	a
WV	6	27	31	45	57	a	a	a	a
Region	346	1435	1508	2546	2903	1.8	2.0	7.5	8.8
Percent change							11.1%		17.3%
Central Region									
AL	0					a	a	a	a
AR	2	3	5	4	5	a	a	a	a
IL	7	22	16	29	20	a	a	a	a
IN	12	47	50	134	108	2.9	2.2	11.2	9.0
IA	3	8	14	26	29	a	a	a	a
KY	6	15	12	39	25	a	a	a	a
LA	45	361	225	1082	574	3.0	2.6	24.0	12.8
MI	226	1222	1058	2790	2405	2.3	2.3	12.3	10.6
MN	82	497	454	1352	1170	2.7	2.6	16.5	14.3
MS	0					a	a	a	a
MO	11	49	28	120	58	2.4	2.1	10.9	5.3
OH	18	78	127	172	401	2.2	3.2	9.6	22.3
OK	1	3	1	9	1	a	a	a	a
TN	0					a	a	a	a
TX	1	2	2	3	3	a	a	a	a
WI	124	533	533	1286	1335	2.4	2.5	10.4	10.8
Region	538	2840	2525	7046	6134	2.4	2.4	12.9	11.7
Percent change							0.0%		-9.3%

a Number of participating hunters was less than 10.

Table 4. Trends (% change per year[a]) in number of American woodcock heard in the Singing-ground Survey as determined by the route regression technique.

State, Province, or Region	2-year trend(1992-93)					9-year (1985-93)				26-year (1968-93)			
	# routes[b]	N[c]	%change	90% C.I.		N	% change	90% CI		N	%change	90% CI	
CT	5	2	-45.1	-54.6	0.0	4	-16.9 ***[d]	-22.4	-10.8	10	-8.0 ***	-15.9	-4.6
DE	0	0				0				3	-33.9	-34.2	14.1
ME	53	38	7.2	-8.6	26.7	58	-3.9 **	-6.1	-1.3	63	-2.0 ***	-3.2	-0.8
MD	12	0				11	-8.1	-37.6	5.2	24	-7.2 ***	-10.7	-4.6
MA	15	10	-3.9	-36.5	31.1	14	-4.3	-9.1	0.6	20	-5.2 ***	-9.3	-2.1
NB	28	19	3.4	-11.2	20.2	52	0.6	-2.0	3.6	63	-1.7 **	-2.9	-0.4
NH	11	6	-15.6	-32.0	29.2	16	-2.0	-6.7	0.9	18	-1.6	-8.3	2.6
NJ	10	4	-25.1 ***	-36.7	-17.7	13	-20.2 ***	-26.7	-8.3	18	-7.3 ***	-8.9	-4.9
NY	67	35	-7.6	-24.0	7.2	79	-0.6	-3.3	2.6	107	-1.3	-3.1	0.1
NS	29	12	-20.5	-36.7	3.1	41	-2.1	-7.1	2.7	55	-2.2 ***	-3.8	-0.7
PA	30	17	13.1	-29.7	64.1	33	-3.1	-9.5	2.6	69	-4.0 ***	-6.6	-2.1
PEI	9	5	-25.6	-46.8	70.1	11	-3.9	-18.9	11.5	13	-0.1	-0.7	1.0
QUE	16	17	5.7	-19.2	34.1	43	-1.1	-3.9	2.1	81	2.4 **	0.6	4.5
RI	0	0				0				3	-7.7 ***	-9.2	-6.7
VT	16	12	31.8	-4.3	72.0	19	-3.6	-7.0	1.1	22	-3.6 **	-5.4	-1.2
VA	13	5	-36.9 *	-74.3	-2.5	26	-6.0	-18.3	3.7	71	-6.6 ***	-8.9	-3.8
WV	17	9	-22.5	-37.4	4.1	28	-4.3 **	-9.9	-0.6	48	-1.2	-2.9	0.1
Eastern	331	192	-0.1	-8.4	8.9	449	-1.5 **	-3.0	-0.4	688	-1.8 ***	-2.5	-1.2
IL	17	2	231.2 ***	133.3	600.0	17	-16.3	-34.7	1.1	38	1.0	-10.1	7.3
IN	11	3	-59.5 ***	-63.6	-43.9	21	4.2 *	0.6	13.6	51	-0.9	-5.7	2.7
MB	1	0				0				0			
MI	116	83	0.2	-10.4	9.9	133	-0.8	-2.6	0.7	142	-0.7	-1.5	0.1
MN	70	43	-1.0	-13.3	14.9	81	-0.6	-2.1	1.0	111	-0.1	-1.2	1.3
OH	36	15	-21.9	-42.1	13.6	34	-3.6	-10.0	1.8	69	-4.5	-6.5	0.5
ON	75	44	-1.0	-12.6	12.2	125	-2.4 *	-4.2	-0.4	138	-0.6	-1.5	0.5
WI	73	50	9.6	-1.7	23.3	86	-3.2 **	-5.3	-1.1	111	-1.8 **	-2.7	-0.5
Central	399	240	0.2	-6.3	5.9	498	-1.7 ***	-2.5	-0.8	661	-0.9 ***	-1.4	-0.4
Continent	730	432	0.0	-4.7	5.2	947	-1.6 ***	-2.4	-0.9	1349	-1.2 ***	-1.6	-0.8

[a] Mean of weighted route trends within each state, province, or region. To estimate the total percent change over several years, use: $100(\%/100+1)^y-100$ where % is the annual change and y is the number of years.

[b] Total number of routes which were run and received prior to 6/1/93.

[c] Number of routes comparable in at least two years with one or more counts greater than zero.

[d] Indicates slope is significantly different from zero: * $P<0.10$, ** $P<0.05$, *** $P<0.01$; significance levels are approximate for states where N<10.

Table 5. Breeding population indices for American woodcock from Woodcock Singing-ground Survey, 1968-1993. Annual indices are calculated as the predicted value from the trend analysis plus the difference between the observed value and predicted value for each year.

State, Province, or Region	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Eastern Region														
CT[b]	--[a]	3.90	3.76	3.10	3.91	2.90	2.88	3.07	1.69	1.81	1.19	1.21	1.06	1.43
DE[b]	86.86	50.59	46.99	29.03	11.30	18.83	23.38	6.45	1.98	2.11	1.59	1.22	--	--
ME	4.68	4.74	5.09	4.55	4.47	4.65	4.59	4.95	4.40	3.98	3.63	3.95	3.53	3.88
MD	3.33	3.09	2.80	2.52	2.29	2.55	2.06	2.25	1.52	1.53	1.72	1.39	1.56	1.49
MA	--	3.38	3.96	4.62	3.37	4.49	3.62	2.10	2.74	1.99	2.38	2.59	1.86	1.86
NB	--	5.38	5.69	5.28	5.55	4.84	5.26	6.03	4.48	5.38	3.98	4.31	3.94	3.94
NH	--	3.63	4.20	3.36	4.05	3.11	4.15	3.46	4.10	3.54	3.44	3.40	3.81	4.22
NJ	3.99	2.95	4.51	5.52	3.51	5.00	4.90	3.69	2.48	2.74	1.62	2.80	1.67	1.40
NY	3.81	4.23	3.18	3.63	3.49	3.54	3.76	3.25	3.27	3.47	2.70	3.12	3.60	3.36
NS	4.29	2.86	2.46	2.99	2.83	2.68	3.32	2.82	2.41	2.39	2.56	2.17	1.99	1.87
PA	2.39	2.15	2.49	2.06	1.90	1.96	1.48	1.74	1.61	1.63	1.27	1.55	1.35	1.33
PEI[b]	--	2.82	2.35	3.08	2.56	2.03	2.74	4.25	3.74	3.29	2.63	3.24	2.39	1.85
QUE	--	--	--	2.64	2.46	1.99	2.30	2.42	1.81	2.02	2.56	2.60	2.88	2.40
RI[b]	--	0.85	1.01	1.60	1.37	1.37	1.02	0.79	0.79	--	0.26	0.46	0.46	0.26
VT	--	2.97	5.02	3.64	4.20	3.50	3.39	3.79	3.42	4.04	3.05	2.85	2.49	2.19
VA	--	1.86	1.95	1.55	1.39	1.06	1.57	1.40	1.16	1.25	0.91	1.04	0.88	0.95
WV	1.15	1.33	0.98	0.92	1.13	0.91	0.90	1.03	0.93	0.96	0.66	0.96	0.81	1.10
Region	3.21	3.07	3.06	2.95	2.87	2.66	2.81	2.82	2.44	2.56	2.22	2.47	2.33	2.35
Central Region														
IL	--	--	0.27	0.29	0.29	0.29	0.25	0.35	0.28	0.28	0.27	0.31	0.25	0.29
IN	1.18	0.90	0.86	0.69	0.89	0.94	0.76	0.80	0.87	0.86	0.79	1.03	0.81	0.87
MI	5.07	5.00	4.81	4.64	4.50	4.69	5.42	5.54	5.06	4.82	5.00	5.07	5.00	4.17
MN	--	3.41	2.91	3.36	2.78	3.12	4.10	3.44	3.22	3.31	3.34	3.37	3.62	3.35
OH	--	--	2.07	2.10	1.78	1.52	1.92	1.48	1.61	1.84	1.48	1.17	1.18	1.38
ON	5.13	5.73	5.46	5.21	5.68	5.26	5.60	5.15	4.83	5.43	5.93	5.60	5.96	5.71
WI	3.70	3.58	3.87	3.41	3.27	3.37	3.44	3.24	3.12	3.48	3.59	3.52	2.96	2.61
Region	2.92	2.83	2.77	2.70	2.65	2.65	2.78	2.75	2.59	2.71	2.67	2.70	2.51	2.48
Continent	3.08	2.98	2.93	2.85	2.78	2.69	2.83	2.82	2.56	2.68	2.48	2.63	2.47	2.46

a Insufficient data or data not available as of 6/1/93.

b Annual indices are approximate due to low sample size.

Table 5. Continued.

State, Province, or Region	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Eastern Region												
CT	1.84	1.42	1.06	0.97	1.35	0.70	1.57	0.69	0.65	0.73	0.49	0.45
DE	--	5.39	0.14	0.09	--	--	--	--	0.02	0.01	--	--
ME	2.68	3.49	3.43	3.38	3.64	3.96	3.72	3.80	2.62	3.32	2.71	2.79
MD	1.49	1.03	0.90	0.89	0.78	0.74	0.77	0.79	0.69	0.93	0.28	0.53
MA	1.58	1.17	2.04	1.59	1.52	1.71	1.71	1.32	1.21	1.43	1.19	1.05
NB	4.01	4.25	3.64	3.80	3.24	3.73	3.75	4.94	3.87	3.69	3.86	4.47
NH	2.43	2.81	2.49	2.65	4.38	2.99	3.07	2.96	2.60	3.40	2.14	2.68
NJ	1.70	1.60	1.87	1.43	1.48	1.66	1.28	1.33	0.88	0.85	0.72	0.72
NY	2.68	3.26	2.51	3.20	2.76	2.52	2.98	2.37	2.80	3.01	2.73	2.29
NS	1.61	2.05	2.04	1.99	2.32	2.02	2.15	2.28	1.68	1.80	2.17	1.97
PA	1.15	1.27	1.33	1.05	1.24	1.17	1.13	0.92	1.09	1.18	0.89	0.93
PEI	2.01	3.12	3.39	2.67	3.51	2.46	3.92	3.66	3.13	2.45	2.27	2.11
QUE	2.35	3.10	2.65	2.98	3.05	3.25	3.58	3.56	3.36	2.71	3.23	3.49
RI	1.10	0.63	0.66	0.22	0.22	--	0.32	0.32	--	0.22	--	--
VT	1.60	2.33	2.39	1.90	2.18	2.25	2.65	2.50	2.32	2.28	1.47	1.58
VA	0.84	0.80	1.13	0.62	0.61	0.66	0.53	0.50	0.46	0.51	0.43	0.38
WV	0.99	1.05	0.85	0.82	0.79	0.92	0.73	0.76	0.83	0.79	0.77	0.72
Region	2.08	2.37	2.26	2.11	2.18	2.21	2.19	2.09	1.99	2.06	1.87	1.86
Central Region												
IL	0.23	0.35	0.27	0.43	0.32	0.44	0.32	0.37	0.24	0.38	0.33	0.36
IN	0.67	0.70	0.71	0.61	0.84	0.60	0.67	0.68	0.77	0.87	0.79	0.71
MI	4.42	3.85	4.29	4.48	4.60	4.23	4.53	4.46	4.34	5.37	3.69	3.63
MN	3.18	2.88	2.55	3.01	3.24	3.08	3.46	3.08	3.48	3.32	2.77	3.05
OH	1.03	1.35	1.22	1.07	0.86	0.92	1.03	0.79	1.09	0.82	0.75	0.81
ON	4.30	4.37	4.66	4.77	4.88	4.96	5.03	5.26	5.16	5.01	4.66	3.99
WI	2.52	2.53	2.72	2.51	3.00	2.99	3.00	2.76	2.79	2.73	2.13	2.12
Region	2.13	2.31	2.22	2.38	2.40	2.41	2.40	2.34	2.33	2.49	2.09	2.09
Continent	2.15	2.39	2.29	2.30	2.35	2.37	2.36	2.28	2.22	2.34	2.04	2.04

a Insufficient data or data not available as of 6/1/93.

b Annual indices are approximate due to low sample size.